A photograph of an electrical substation at sunset. The sun is low on the horizon, creating a bright orange and yellow glow that silhouettes the complex metal structures, towers, and power lines of the facility. The sky is a gradient of warm colors from orange to a pale yellow.

SF₆ and the Environment: Emission Reduction Strategies

SCE's Experiences with SF₆

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OVERVIEW

- SCE's experiences with SF₆
 - SF₆ gas team
 - Circuit breaker replacement program
 - Emission reduction
- Future development

SF₆ GAS TEAM

Goals

- Establish uniformity
- Environmental
- Pricing
- Transportation
- Training
- Equipment



SF₆ GAS TEAM

- Environmental
 - EPA - US governing agency
 - Memorandum of Understanding (MOU)
 - Potential effects of the Kyoto treaty
- Strategic sourcing
 - Pricing
 - Residual tracking
 - Understand gas supplier process

SF₆ GAS TEAM

- Resource guide
 - Safety
 - Environmental
 - Gas handling
 - Sampling
 - Equipment
 - Transportation



SF₆ GAS TEAM

- Training
 - Gas handling process/procedures
 - Documentation
 - Consistency
- Transportation
 - CFR 49 restrictions/ASME storage tanks
 - Code of Federal Regulations DOT Standards 49 Section 173.115 (b)

SF₆ GAS TEAM

Equipment

High Pressure System

- DOT cylinder storage
- Unlimited storage
- High-pressure system requirements, e.g., piping, hoses, valves, and fittings
- Slower transfer rate
- Cylinder certification every 5 years

Cool Assisted/ASME Storage Tanks

- Complexities with refrigeration units
- Transportation restrictions
- Limited storage
- Fast transfer rate

SF₆ GAS TEAM

- Gas management program

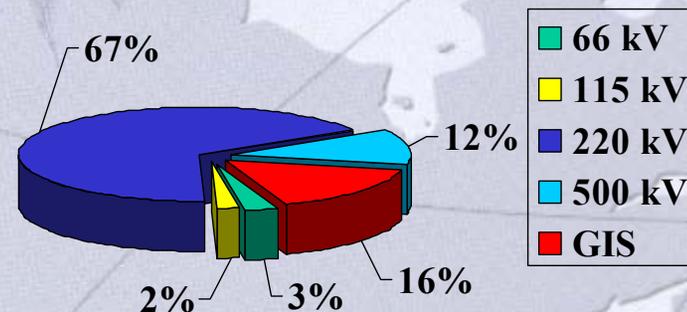
- Circuit breaker survey

- 1,850 gas circuit breakers
 - Two GIS facilities
 - Over 500,000 lbs. SF₆ total

- Inventory

- Tracking

- Weigh cylinders before returning to supplier
 - Cylinders containing more than 15 lbs. of gas are not returned
 - Log and report monthly
 - Residual tracking



CIRCUIT BREAKER REPLACEMENT PROGRAM

Benefits of New Technology

- Lower leak rate
- Major maintenance intervals extended by 300%
 - Resource deployed to more productive work
- Reduction in spare parts inventory/re-engineering
 - Obsolete parts not available
 - Minimizes extended outages
- Improved performance
 - Faults removed from system quicker
 - Reduces stress on transformers, disc., etc.
 - Enhances power quality

CIRCUIT BREAKER REPLACEMENT PROGRAM

Benefits of New Technology

- Improved performance
 - Links with improvements from system automation
 - Improved capacitor switching capability
- Statistically lower major failure rates by 67%
 - More reliable class of equipment

Targeted Circuit Breakers

- Two pressure dead tank
- Air blast live tank
- Oil

CIRCUIT BREAKER REPLACEMENT PROGRAM

Gas Handling

- Test gas before evacuating (purity and moisture)
- Store gas in cylinders for reuse in new equipment
- Maintain gas quality (98%)
- Recycle contaminated gas
- Manage surplus gas

Equipment

- High pressure cylinder storage system
- Four cylinder storage (non-hazmat regulated)
- Programmable internal and external weight scale
- Pre-filter

EMISSION REDUCTION

- Leak Mitigation Program
 - Repair major leaks
 - Manifolds/valves
 - Bushing replacement
- Track usage
 - Product purchased
 - Product returned
 - Inventory
- Results expected
 - Emission reduction of 5%
 - Target emission reduction of 3%
 - Cost savings

FUTURE DEVELOPMENT

- SF₆ an asset to be managed
- Leak-free/maintenance-free equipment
- Utility industry driver
- Lessons learned
 - Specification
 - Training
 - Recycling
 - Transportation/storage regulations

CONCLUSION

“Properly managing SF₆ inventories and tracking usage reduces operating and maintenance costs.”

Southern California Edison

